

## Description

# [COUPLING DEVICE FOR A DETACHABLE SHOE UPPER ON A SHOE]

### BACKGROUND OF INVENTION

[0001] The present invention relates to footwear having a device associated with a sole and a detachable upper shoe part that allows a user to exchange shoe uppers and shoe soles at will.

[0002] In slipper-type footwear of the type comprising a molded sole and an upper part, particularly although not exclusively lady shoes, it is desirable to have a variety of shoe uppers which can be exchanged onto a sole at will, for instance to match colors and patterns of the attire for a particular occasion.

[0003] U.S. Patent No. 5,896,684, issued on 27 April, 1999 to Lin, discloses a simple shoe such as a sandal or slipper having detachable toe and ankle straps. Each strap has at least a pair of mounting strips, each having a serrated plug strip, that fasten to a corresponding pair of locating

members in the sole of the shoe. The locating members have a serrated constraint tongue that engages the serrated plug strips to secure the uppers to the sole. A pin-like tool is manipulated by the user for disengaging the serrated plug strip from the constraint tongue to detach the shoe upper from the sole. A housing means is provided in the shoe upper for keeping the tool at hand.

[0004] The need for a tool to detach the shoe upper from the sole represents several disadvantages in practice. Maneuverings and wedging a tool in between the plug strip and the tongue is unappealing to most ladies. Furthermore, although housing means are provided for the tool, it could get lost. Again, many ladies do not enjoy tinkering about with a tool box to look for a suitable replacement, such as a screw-driver, especially after they are dressed up and have decided that they prefer a different shoe color or pattern to match a particular dress, purse, hat, etc.

#### **SUMMARY OF INVENTION**

[0005] The present invention provides a coupling device comprising elements affixed to the sole and shoe upper of a shoe to enable a user to fasten the shoe upper to the sole, and to easily detach the shoe upper from the sole without requiring a separate tool. The shoe upper can be detached

with hardly any force, such as by a lady or a young child, yet the coupling device resists unwillful detachment under extreme walking, jogging, jumping and climbing conditions, whatever the terrain. The shoes of the invention can have any design or shoe type, such as a slipper or sandal, ranging from leisure to evening dress. The invention provides a coupling device for use in detachably coupling a shoe upper to a shoe sole to enable a user to assemble and disassemble the shoe at will, the sole having a body having a foot-bearing topside bounded by at least one lateral side, the coupling device comprising: a socket, embeddable in the sole, the socket comprising: (i) an inner wall, an outer wall and two connecting side walls, forming a shaft having a slotted opening penetrable through a foot-bearing topside of the sole; (ii) a tongue comprising a plurality of ratchet teeth, the tongue being resiliently movable from an unbiased engaged position and a biased disengaged position; and (iii) a button, depressable by a finger of the user, the button having a first rest position and a second depressed position, the button being in direct communication with the tongue whereby when the button is in its rest position, the tongue is in its unbiased engaged position, and when the button is in the de-

pressed position, the tongue is in its biased disengaged position; and (b) a plug having a generally flat body and comprising: (i) an upper portion affixable to the shoe upper; and (ii) at least one prong insertable into the shaft through the slotted opening, the prong comprising a plurality of complementary ratcheted teeth that detachably engage with the ratcheted teeth of the tongue in its unbiased engaged position upon insertion of the plug into the shaft, thereby coupling the plug to the socket; whereby when the button is depressed to its depressed position, the tongue moves to the biased disengaged position, whereupon the ratcheted teeth of the tongue disengage from the ratcheted teeth of prong, and thereby the plug is uncoupled from the socket.

[0006] The invention also provides a new footwear manufacturing technique, utilizing the coupling device of the invention, to incorporate more and new designs, functional lines and shoetrees with versatility and economy. The invention includes a method for manufacturing a socket, for embedding in the sole of a shoe and receiving for insertion therein a removable plug for coupling a detachable shoe upper to the sole to enable a user to assemble and disassemble the shoe at will. The method comprises: (a) mold-

ing integrally the socket walls, base, tongue and button into a single piece, wherein the base is molded as a flat sheet having a first base portion forming an open bottom end of the socket shaft, a thin hinge portion along one side of the first portion, and a second base portion joined by the hinge portion to the first portion; and a frangible membrane affixed to the button and the outer wall to temporarily seal off the orifice in the outer socket wall; (b) folding the second base portion back under the first base portion to form the base of the socket shaft, thereby forming an assembled socket; (c) molding the assembled socket into a resin-based shoe sole using a flowable resin; and (d) depressing the button, thereby breaking the frangible membrane. The method further preferably comprises the step of placing a cap over the assembled socket, the cap having an outer resilient wall enclosing an air space surrounding the button, thereby preventing flowable resin from entering the air space during molding of the sole.

[0007] The invention also comprises a method where a plurality of a plugs are attached to a shoe upper, the plug having a generally flat body and comprising: (i) an upper portion affixed to the shoe upper; and (ii) at least one prong in-

sertable into the shaft through the slotted opening, the prong comprising a plurality of complementary ratcheted teeth that detachably engage with the ratcheted teeth of the tongue in its unbiased engaged position upon insertion of the plug into the shaft, thereby coupling the plug to the socket, and thereby attaching the shoe upper to the sole. The invention also provides a shoe that is adaptable to an array of exchangeable shoe uppers.

[0008] The invention also provides a two-part coupling device that is hardly visible to observers of a lady wearing the shoe, yet is simple for her to access.

[0009] The invention further provides a method for molding a shoe sole comprising a shoe upper attachment/detachment socket.

#### **BRIEF DESCRIPTION OF DRAWINGS**

[0010] Figure 1 is a perspective view of a sole and a detached shoe upper that can be assembled into a shoe by means of two or more coupling devices of the present invention consisting of sockets 11 and plugs 15.

[0011] Figure 2 is a plan view of a socket embedded in the shoe sole showing a partial cut-away of the sole.

[0012] Figure 3 is an elevation view of a two-pronged plug.

- [0013] Figure 4 is an enlarged cross-sectional view through lines 4-4 of figure 3.
- [0014] Figure 5 is a perspective view partially cut away of a coupling device in an uncoupled position.
- [0015] Figure 6 is a cross-sectional view of the coupling device of figure 5 through line 6-6, shown in a coupled position.
- [0016] Figure 7 is a cross-sectional view of the coupling device of figure 5 taken through line 6-6, shown in the uncoupled position, with the button depressed and with the plug withdrawn.
- [0017] Figure 8A is a plan view of a one-piece socket for a coupling device of the invention.
- [0018] Figure 8B is a cross-sectional view of the one-piece socket of Figure 8A through line 8B-8B.
- [0019] Figure 9 is a partial view of the cross-sectional view of the socket of Figure 8B, with the button depressed and showing a breached socket sidewall.
- [0020] Figure 10 is a perspective view of a cap used with another coupling device of the invention.
- [0021] Figure 11 is a cross-sectional view of the socket of Figure 8A with the cap of Figure 10, when viewed through sectional line 11-11 of Figure 9.

## **DETAILED DESCRIPTION**

[0022] Terminology: As used herein, "upper"(when used as a noun) or "shoe upper" refer to an upper part of a shoe or other footwear, and can include a toecap part, a toecap patch, or an open-toe strap that covers the forward part of the foot of a user, can include ankle and heel straps, and can include unitary and integral combinations thereof.

[0023] As used herein, "horizontal"refers to a normal shoe position, i.e. with the sole resting on a horizontal surface.

[0024] As used herein, "outer"and "inner"refer to elements of the coupling device positioned nearer and further away, respectively, from the nearest lateral side of the sole.

[0025] The coupling device comprises two parts: a socket and a plug. The socket is typically embedded into a shoe sole, while the plug is typically affixed to the shoe upper. However, the socket can be affixed to one of the sole and shoe upper, while the plug can be affixed to the other of the sole and shoe upper.

[0026] The socket comprises a plurality of sidewalls that form a shaft that is adapted to receive the plug, a toothed tongue for engaging and latching to the plug, and an integral release means for releasing the tongue from the plug, whereby the shoe upper can be detached from the sole. The tongue is resiliently connected at a first end to at



least one of the inner wall or the outer wall, and is preferably resiliently connected at an upper end by a resilient bridge to the inner wall proximate the slotted opening.

The tongue comprises an upper portion and a lower portion having a surface facing the outer wall, the surface preferably having two toothed surfaces, each comprising the plurality of ratcheted teeth, astride a middle portion.

[0027] Each plug and socket part can be separately advantageously manufactured in one-piece.

[0028] In a preferred embodiment, the plug has two spaced-apart toothed prongs, and the tongue has an end resiliently affixed to a sidewall of the socket. The integral release means, preferably a button, extends through an orifice in the socket toward a nearest sidewall of the sole. The button communicates with the tongue by a stem joined to the button, the stem traversing the outer wall and connecting to a lower portion of the tongue. Within the socket, the button preferably passes between the pair of toothed prongs, and is integrally attached to the tongue, preferably to the middle, lower portion of the tongue, to communicate the finger pressure applied to the button. The applied pressure on the button displaces the tongue away from the plug sufficiently to separate the re-

spective engaged teeth of the tongue and the prongs, thereby disengaging and releasing the plug.

[0029] Preferably the button is positioned within the sole in close proximity to the lateral outer wall 9, as shown in FIG. 2.

The sole can have a raised mark 19 in lateral sidewall indicating the position of the button positioned proximately thereto. Alternatively, the button may barely project from the flush surface of the sidewall of the sole. The invention provides for the button to go generally unnoticed by a casual observer, yet is easily manipulated simply by pressing with a finger, without use of tools.

[0030] The invention further comprises a method of manufacture wherein the shaft of the socket is sealed to keep it free from mold resin during molding of the sole body into which it is incorporated. The method comprises providing a socket body having a fold-over base that can cover the socket opening. Preferably, the socket has a frangible membrane that closes off the socket space inside from the button housing. Preferably, the button has a base end joined to the stem, the outer wall has an inner-facing surface, and the membrane joins the button base end and the inner surface of the outer wall. The thin membrane temporarily seals off the orifice in the outer wall to pre-

vent flowable resin from entering the socket during molding of the sole. The frangible membrane can be breached or broken after the socket has been molded into the sole, by simply pressing the button, thereby making the coupling device operational.

[0031] In a preferred embodiment, the socket is enclosed around its sidewalls by a cap prior to placing the socket inside the molded sole. The cap maintains an air gap in the space around the button. The cap serves to keep the injected molding resin out from around the button, and provides a projecting surface outward from and engagable with the button to facilitate access to the button by a user. Although the cap obviates the need for the membrane as a barrier to molding resin, the membrane is preferably also used since it helps to withstand inward depression of the button under the injection pressures of the molding resin.

[0032] Construction and Operation: Figure 1 shows a first embodiment of the invention of a shoe, such as a lady's high-heeled slipper, comprising a sole 1 molded from a resin and a shoe upper 3. The shoe sole 1 has a top or foot-bearing surface 5, and a lateral outer wall 9. Six sockets 11, forming part of a like number of coupling devices, are embedded in the body of the sole 1. A like

number of plugs 15 are attached to the bottom edge 7 of the shoe upper 3. Each socket 11 comprises a tongue 33 to engage with its corresponding plug 15. The tongue 33 is associated with a button 45 positioned proximate to the lateral outer wall 9 of the sole.

[0033] Figure 2 shows a plan view of the socket 11 positioned in the top surface 5 of the sole 1. The socket 11 has a shaft 27 and a slot-shaped opening 13 level with the top surface 5 that can receive a corresponding plug 15. The socket shaft 27 is generally oriented parallel to the nearest lateral side 9 of the sole 1. The tongue 33 communicates with the button 45 via short stem 47 that traverses an orifice 41 (see Figure 8B) in the outer wall 43 of the socket. The rounded button 45 is positioned proximate the lateral outer wall 9, as shown by the cut-away portion of the sole of Figure 2. The button 45 is preferably positioned adjacent to the outer wall 9 of the sole whereby a hump mark 19, formed from the sole resin material covering the button 45, identifies the position of the button 45 to allow a user to locate and depress the button with a finger, while being generally unnoticable.

[0034] Figure 3 shows a plug 15. The plug 15 is molded as a substantially flat piece from a suitable, generally stiff ma-

terial selected from materials including but not limited to plastics, metal, and rubber. Preferably, the plug 15 has a top portion 17 that is affixed to the edge 7 of the shoe upper 3 by any suitable means, such as stitching or adhesive. The top portion 17 is preferably trapezoidal, measuring about 20.5 mm across the top, 11 mm down, and about 1.1 mm thick.

[0035] A pair of prongs 21 depends from the top portion 17, leaving a rectangular cut-out portion 23 between the prongs. Preferably, each prong 21 is about 13 mm long and 8 mm across, and has an inner face ratcheted with a plurality of ratchet teeth 25 that have a 1 mm pitch. Figure 4 is a sectional view of a prong that shows the shape of the teeth 25. The thickness of each prong is preferably about 2.10 mm at its widest portion and 1.34 mm at its thinner portion. The teeth 25 are shaped in a typical saw-tooth configuration such that a first edge of each tooth 25 is generally perpendicular to the direction of movement of the prong 21 during insertion into the socket opening 13 for properly latching into the socket with the teeth of the tongue. The adjacent second edge of each tooth 25 is at an angle of about 30° to said direction of movement, to facilitate insertion.

[0036] As illustrated in Figures 5 and 6, the socket 11 comprises a prism body having an outer wall 43, an inner wall 35, and connecting walls which enclose a shaft 27, and an integral laminar base 29. The sidewalls and the base are fixed within the sole 1. The base 29 closes off the bottom of the shaft 27 of the socket 11. The base 29 is preferably provided with holes 31A and cut-outs 31B for better anchoring of the socket 11 into the resin of the sole.

[0037] A tongue 33 has a top edge attached to the inner wall 35 by a relatively thin resilient hinge portion 37 that enables the tongue member 33 to sway or pivot in an arch toward and away from the inner wall 35. As shown in Figure 6, the outward-facing surface of the tongue 33 has a plurality of vertically spaced ratchet teeth 39 that are saw-toothed shaped and are dimensioned to mesh with the plug teeth 25 when the plug 15 is inserted in the socket 11. Short flat valleys 26, as shown in Figure 4, positioned between each tooth 25 of the prong 21 and tooth 39 of the tongue 33, ensure proper engagement even when the prong 21 is not inserted perfectly straight into the socket 11, and preserve the sharp edges of the teeth from breaking off. For a 1.0 mm spacing between the teeth, the flat valley 26 can be about 0.3 mm, or 30% of the spacing.

[0038] A short stem 47 connects the button 45 to the tongue 33, at about the middle of the tongue member 33 between the pairs of extended teeth 39. The shaft 27 is sized to accommodate the plug 15. The shaft is preferably about 10.0 mm long, 28.5 mm wide and 2.3 mm across (i.e. the shaft portion receiving the plug prongs 21 and excluding the shaft portion housing the tongue 33 or 5.9 mm across including the portion housing the tongue 33). The socket walls 35, 43 are preferably 2.2 mm thick and formed at about a 12° angle with the base 29 so that the plug 15 is not exactly vertical when plugged into the socket 11. The tongue 33 is preferably about 24.5 mm wide and can be pushed back 14° from its normal position (i.e. when the plane of its teeth 39 is parallel to the inner and outer socket walls 35, 43) against the inner wall 35, and the resilient hinge 37 is preferably about 0.4 mm thick. Preferably, the orifice 41 is about 11.8 mm wide and 6.0 mm down, the button 45 is about 5.3 mm long, 3.0 mm down and 8.7 mm at the base, narrowing at 8° towards the outer end, and the stem 47 is about 6.0 mm across.

[0039] A user can attach a shoe upper 3 to a sole 1 by inserting and pushing each plug 15 down into its corresponding socket 11, until each prong 21 engages the tongue 33. To

exchange the shoe upper for one of a different pattern, color or design, the user depresses with a finger each button 45, causing the respective stem 47 to urge the tongue member 33 towards the inner wall 35 of the socket 11 sufficiently for the teeth 39 of the tongue 33 thereof to disengage and unlatch from the plug teeth 25, and pulls the unlatched plug 15 upwards. No accessory tool is kept at hand, fetched or searched for, and scant human force is required to unlatch the plugs. The buttons 39 are sufficiently conspicuously arranged so that a user can locate and press the buttons, even if her fingernails are long or have just been painted, and yet are sufficiently concealed so as not to interfere with the aesthetics of the shoe sole.

[0040] Manufacture: The sockets 11, the plugs 15 and the sole 1 can be molded. Integrated one-piece constructions are preferred. Methods for molding the plug 15 are well known in the art.

[0041] The socket elements, including the socket walls, base, tongue, stem and button, are preferably formed integrally in a single piece. However, creating a die for manufacturing the socket 11 is complicated when the tongue 33 and button 45 are to be integrated into a single piece with the



socket walls 35, 43 and base 29.

[0042] According to another aspect of the invention, the socket 11 is initially molded with a shaft 27 open from the top opening 13 to its bottom. Figures 8A and 8B illustrate the initial socket design. The die is shaped to include an extended base sheet comprised of a proximal portion 51 about the bottom shaft opening and a remote portion 53 connected to the proximal portion by a thin hinge portion 55. The hinge portion 55 is preferably about 0.2 mm thick. The base portions 51, 53, and 55 are molded integrally with the rest of the socket components in one piece.

[0043] Once the mould is set and the socket 11 is removed from the die, the remote base portion 53 is folded back under the proximal base portion 51 about the base hinge portion 55, thereby closing off the base 29 of the socket shaft 27. The socket 11 can thereafter be placed in a die for molding the sole 1, with the socket opening 13 against the bottom of the upside-down sole die. Both ends of the shaft 27 are thus effectively sealed to avoid resinous sole material from seeping into the shaft, which if it remained would obstruct the insertion of the plug during use.

[0044] A further problem of keeping the flowable sole material out of the socket shaft during molding is associated with

the orifice 41 in the outer wall 43. The orifice 41 allows the button 45 and/or stem 47 to movably traverse the outside wall 43. Figure 9 shows a preferred embodiment that provides a solution to this problem. The socket 11 is molded with a thin, frangible membrane 59, preferably about 0.1 mm thick, flush with the outer wall 43 that seals the orifice 41. The membrane 59 prevents resin from seeping into the socket 11 through the orifice 41 during the molding of the sole.

[0045] Furthermore, the button 45 can be shaped so as to provide a large base area bearing against the membrane 59. The sole 1 is cast in a die wherein the entire socket shaft 27 is maintained free of resinous material. Once the sole has set and is removed from the die, with the sockets 11 (preferably about six sockets per shoe) embedded therein, the release operation can include a step of pressing each button 45 to breach the frangible membrane 59, since the latter has already served its resin prevention purpose.

[0046] A more preferred embodiment of the invention is shown in Figures 10 and 11. Figure 10 shows a cap 61. Figure 11 is a sectional view of the socket of Figure 8A, taken through a horizontal plane as shown in Figure 9, showing the cap 61 positioned to surround the outer wall 43, side-

walls, and part of the inner wall 35 of the socket 11, thereby covering the button 45 and enclosing an air space environment or gap 63 surrounding the button 45. The cap 61 is generally a four-sided piece of plastic partially opened at an inner side 65, and has a rounded convex outer side 67 which, in position, forms a cover for the button 45. During manufacture of the sole 1, the outer wall 67 of the cap 61 prevents the flowable resin (for example, polyurethane) that is injected into the mold from entering in the air gap 63, which upon curing would prevent the button from being depressed with a finger.

[0047] The outer cap wall 61 further provides a button area which is both enlarged and resilient. The cover wall 67 is more preferably convexly curved to provide resilient inward flexure for optimum operation.

[0048] Figure 11 is a sectional view of the socket of Figure 8A, taken through a horizontal plane as shown in Figure 9. One or more recesses 69 provided at the bottom of the sidewalls accommodate anchorage flanges 71 provided in the socket base, as shown in Figure 5.

[0049] Although the cover wall 67 provides the resin-exclusion function of the membrane 59 in the first embodiment, it is preferred to include the membrane 59 since it resists de-

pression of the cover wall 67 and the button 45 under the pressure of the injected molding resin, which otherwise might prematurely depress the cover wall and button and, if cured under this condition, could cause the coupling device to malfunction.

[0050] While the invention has been described with reference to preferred embodiments, it will be understood by those skilled in the art that various changes can be made and equivalents can be substituted for elements thereof without departing from the scope of the invention. In addition, many modifications can be made to adapt a particular situation or step to the teachings of the invention includes all embodiments falling within the scope of the appended claims.